

OBSERVATIONS ON FUNGAL SUCCESSION
ON RECENT VOLCANIC DEPOSITS OF MOUNT ST. HELENS

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ABSTRACT

Succession of macro- and microfungi on recent volcanic deposits of Mount St. Helens is being studied. Large areas of tephra were colonized by the sexual and asexual states of *Anthracobia melaloma* within 20 days of the May 18, 1980 eruption. The propagules of these fungi are heat tolerant and do not require high temperatures to activate germination. Species of *Penicillium* and *Aspergillus* dominated the mycoflora in tephra samples obtained on July 1, 1980. In fall, 1981 we observed that erosion of tephra is important in exposing buried organic material. Multitudes of Basidiomycete and Ascomycete sporocarps appeared along organic horizons exposed by rill and stream erosion of tephra; surrounding tephra remained bare of sporocarps. We have found that carbonicolous Ascomycetes, normally found on burned forest soils, were primary colonizers of tephra and were still fruiting prolifically in fall, 1981. Fungal succession on tephra surfaces is proceeding relatively slowly compared to that in periodically burned forests and grasslands. The thickness of tephra overlying forest soil, its low nutrient status, and the paucity of organic matter in many areas have slowed fungal colonization and will likely influence colonization of tephra by fungi competitive with carbonicolous Ascomycetes and Basidiomycetes.

On May 18, 1980, "Mt. St. Helens shattered a 120-year dormant interval with an explosive eruption that devastated most of the immediate area in a 160° sector north of the mountain, ...triggering numerous mudslides and destructive floods, and blanketing much of eastern Washington, northern Idaho, and western Montana with volcanic ash" (Rosenfeld, 1980). The lateral blast virtually denuded every exposed slope to a 10 km radius on the north side of the mountain and deposited up to 2 m of ash and rock debris. Beyond this, up to about a 15 km radius, trees were uprooted or snapped off at their bases and stripped of leaves and branches. In a zone of several hundred meters beyond this, vegetation was left standing but all above ground parts killed. Debris which exploded from the breach in the north side of the crater formed a debris fan to Spirit Lake and was subsequently covered by pyroclastic deposits up to 20 m deep (Rosenfeld, 1980). Since then, several lesser eruptions have added to the

tephra and pyroclastic deposits.

The tephra deposits vary somewhat in chemical and physical properties, depending on location and from which of the several eruptions they were derived (Cook et al., 1981; Fruchter et al., 1980; Hooper et al., 1980). Analyses of our samples from the devastation area indicate pH ranging from 6.1 to 6.8 with little available phosphorus (0.057%), potassium (0.070%), or nitrogen (0.189%) and virtually no organic matter. Cation exchange capacity is only 1.27 to 2.19. Particle size fractions are mostly pumice gravel, sand and silt, with a very low clay fraction.

The tephra was heat sterilized when ejected from the volcano. Six weeks after the eruption, we found pyroclastic deposit samples still free of macro- and microfungi. Tephra from the August 7, 1980 eruption, caught directly from the air on media in Petri dishes was sterile.

Although research on fungal succession in situations analogous to that of Mount St. Helens are lacking, studies on fungal succession in burned forests and grasslands provide relevant information. El-Abyad and Webster (1968a, 1968b) found that germination and growth of carbonicolous *Discomycetes* was frequently enhanced in alkaline soil, and that sporocarps developed poorly or not at all in the presence of non-pasteurized pasture soil. They suggested that soil fungistatic properties and competition by other soil microorganisms might account for reduced sporocarp production. Peterson (1970) followed the succession of macrofungi over several years in burned Danish forests. He found a predominance of carbonicolous *Ascomycetes* the year following burning. Wicklow (1975), Wicklow and Zak (1979) and Zak and Wicklow (1978a, 1978b, 1980) have studied post-fire succession of carbonicolous *Ascomycetes* in the prairie grasslands of North America with emphasis on fungal mechanisms for adaptation to post-fire substrates. They theorized that high temperatures promote germination of carbonicolous *Ascomycete* spores and reduce populations of fungal competitors. Their work was largely based on the presence of sporocarps in burn sites rather than abundance of vegetative mycelium. They also found that the presence of an underlying layer of non-pasteurized soil reduced the number of sporocarps produced by carbonicolous *Ascomycetes* on burned or steamed soil.

On July 1, 1980, we observed that large areas of tephra were colonized by the carbonicolous *Discomycete* *Anthracobia melaloma* (Alb. & Schw. ex Fr.) Boud. and *Pyrenomycete* *Gelasinospora reticulispota* (Greis) Moreau. Sexual spores of many *Discomycetes* give rise to anamorphic states which produce abundant asexual conidia. *Anthracobia melaloma* produced large, conidium-producing mats on surface tephra. The asexual, aerially dispersed spores are important for species dispersal. Green algae and bryophyte protonema developed immediately around the sporocarps of *A. melaloma* and nowhere else. However, *A. melaloma* often grew in the absence of algae and bryophytes. Thus the fungus appears to be independent of the algae and bryophytes but the latter depend on colonies of the fungus as microsites for establishment. In July, 1981 we observed that decadent sporocarps of *Rhizina undulata* Fr., *Peziza* spp., and *Plicaria* spp. were covered and ringed by algae and bryophytes. The

green plant colonies thereby established subsequently continued to expand, albeit slowly. Griggs (1933) noted an association between fungi and liverworts at Katmai volcano, but his observations were made too long after initial colonization to determine which organism came first.

Samples of tephra obtained on July 10, 1980 were tested for the presence of viable fungal propagules using standard dilution platings. Species of *Penicillium* and *Aspergillus* predominated the Hyphomycete flora. A similar situation existed in a landslide deposit of old, volcanic debris from above timberline on Mount Rainier, Washington (Bollen et al., 1967, 1969).

In June, 1981 we found an abundance of carbonicolous Discomycetes and a few carbonicolous Basidiomycetes growing on the tephra; no Basidiomycetes had been found on tephra in July, 1980. The Basidiomycetes were represented by species of *Psathyrella*, *Pholiota* and *Coprinus*, and the Ascomycetes by *Anthracoobia*, *Gyromitra*, *Morchella*, *Octospora*, *Peziza*, *Plicaria*, and *Trichophaea*. The Myxomycetes *Lycogala* and *Fuligo* were common on fallen woody debris. By July, 1981 the tephra surfaces were nearly dry and surface fungi could only be found in areas which remained moist in the shade of emerging vascular plants and fallen logs.

After the fall rains of 1981 an increased number of Basidiomycete species were found and carbonicolous Discomycetes continued sporocarp production. The most conspicuous Basidiomycete found throughout the devastated area was *Omphalina maura* (Fr.) Quelet which normally occurs on burned forest soils in western North America. The Discomycetes fruiting on the tephra at this time were primary colonizers found the previous year, and their continued fructifications indicate that fungal succession on tephra surfaces appears to be proceeding relatively slowly compared to that in periodically burned forests and grasslands. Zak and Wicklow (1980) found that the post-fire bloom of carbonicolous Ascomycete sporocarps is ephemeral and soon inhibited by other fungal competitors. The thickness of tephra overlying forest soil, its low nutrient status, and the paucity of organic matter in many areas may have slowed colonization by other fungi and will likely restrict colonization to fungi which are competitive with carbonicolous Ascomycetes and Basidiomycetes.

In fall, 1981 we observed that erosion of tephra is important in exposing buried organic material important to fungal colonization. Multitudes of Basidiomycete and Ascomycete sporocarps appeared along organic horizons exposed by rill and stream erosion of tephra; surrounding tephra remained bare of sporocarps. Species occurring along these horizons include *Omphalina maura*, *Peziza* spp., *Psathyrella* spp., and *Scutellinia scutellata* (L. ex Fr.) Lambotte. In addition, sheet erosion of tephra surfaces has provided a buildup of organic debris, mostly conifer needles, washed onto flat surfaces. We have found these areas covered with fructifications of *Omphalina maura* and *Hypocopia merderia* Fr.

Figure 1 graphically displays the number of species found at succeeding collecting dates. The graph is restricted to Ascomycetes and Basidiomycetes since we have not completed our studies and identification of Hyphomycetes collected to date. Clearly this graph does

not represent the entire range of species found in the devastated areas, but only those found in our collecting sites, ca 20 km NE of the blast crater. Table 1 lists all of the species of fungi thus far identified by us.

We will continue to monitor fungal succession at the Mount St. Helens devastation area over the next several years. We hope our study of this unique event will further our understanding of vegetation development on volcanic deposits in similar habitats.

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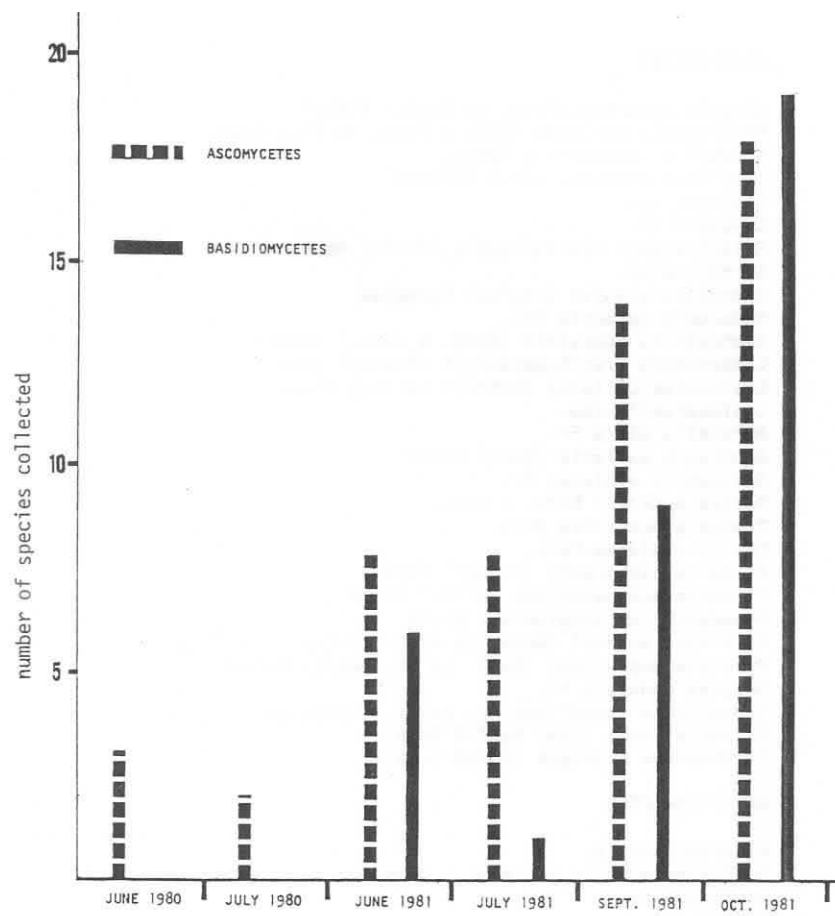


Figure 1. Number of species of Ascomycetes and Basidiomycetes collected at the Mount St. Helens devastation zone.

Table 1
Fungi identified from the Mt. St. Helens devastation zone

ASCOMYCETES

Aleuria aurantia (Pers. ex Hook.) Fuckel
Anthracobia melaloma (Alb. & Schw. ex Fr.) Boud.
Ascobolus carbonarius Karst.
Claviceps purpurea (Fr.) Tulasne
Coprotus sp.
Erysiphe sp.
Gelasinospora reticulispora (Greis) Moreau
Gyromitra sp.
Gyromitra recurva (Snyder) Harmajaa
Hypocopra merderia Fr.
Lachnellula agassizii (Berk. & Curt.) Dennis
Lamprospora crec'hqueraultii (Crouan) Boud.
Lasiobolus ciliatus (Schmidt ex Fr.) Boud.
Lasiosphaeria spp.
Morchella elata Fr.
Octospora axillaris (Nees) Moser
Ombrophila violacea Fr.
Peziza petersii Berk. & Curt.
Peziza praetervisa Bres.
Peziza violacea Pers.
Plicaria carbonaria (Fuckel) Fuckel
Plicaria endocarpoides (Berk.) Rifai
Pseudeurotium zonatum van Beyma
Pulvinula archeri (Berk. in Hook.) Rifai
Pyronema omphalodes (Bull. ex St. Amans) Fuckel
Rhizina undulata Fr.
Scutellinia scutellata (L. ex Fr.) Lambotte
Tarzetta rosea (Rea) Korf & Rogers
Trichophaea abundans (Karst.) Karst.

BASIDIOMYCETES

Aleurodiscus sp.
Auricularia auricula (Hook.) Underw.
Coprinus sp.
Cortinarius spp.
Dacryomyces sp.
Exidia sp.
Galerina sp.
Guepinopsis alpinus (Tracy & Earle) Bres.
Hygrophorus sp.
Laccaria sp.
Lycoperdon sp.
Marasmius spp.
Mycena spp.

Table 1 (con't.)
Fungi identified from the Mt. St. Helens devastation zone

BASIDIOMYCETES (con't.)

Naematoloma sp.
Omphalina spp.
Omphalina maura (Fr.) Quelet
Pholiota spp.
Pholiota fulvozonata Smith & Hesler
Pholiota subsaponacea Smith & Hesler
Psathyrella spp.
Psathyrella carbonicola Smith
Schizophyllum commune (Fr.) Fr.

HYPHOMYCETES

Acremonium spp.
Acremonium kiliense Grutz
Aspergillus fischeri Wehmer var. glaber Fennell & Raper
Aspergillus versicolor (Bain & Sart.) Thom & Church
Aureobasidium pullulans (deBary) Arnaud
Botrytis sp.
Chromelosporium sp.
Chrysosporium sp.
Cladosporium sphaerospermum Penzig
Cystodendron sp.
Diplococcium sp.
Dothiorella sp.
Epicoccum purpurascens Ehrenb. ex Schlecht
Oedocephalum spp.
Oidiodendron sp.
Penicillium brevi-compactum Dierckx
Penicillium citrinum Thom
Penicillium claviforme Bain.
Penicillium frequentans Westling
Penicillium spinulosum Thom
Penicillium terrestre Jensen
Phoma sp.
Pithomyces sp.
Rhodotorula sp.
Thysanophora penicilloides (Roum.) Kendrick
Trichoderma harzianum Rifai
Trichoderma koeningii Oudem.
Trichoderma polysporum (Link ex Fr.) Rifai
Trichoderma viride Pers. ex Gray
Ulocladium atrum -reuss
Ulocladium botrytis Preuss

Table 1 (con't.)

Fungi identified from the Mt. St. Helens devastation zone

MYXOMYCETES

Fuligo septica (L.) Web.
Lycogala sp.

ZYGOMYCETES

Absidia spp.
Endogone sp.
Endogone pisiformis Link ex Fr.
Mucor spp.

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